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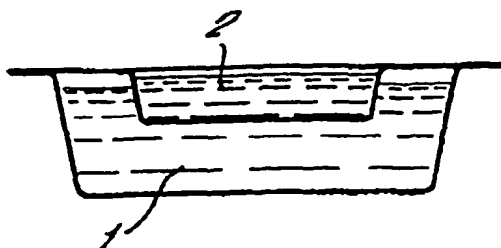
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(54) Title: WATER SOLUBLE CONTAINERS COMPRISING AT LEAST TWO COMPARTMENTS



(57) Abstract: A process for producing a water-soluble article comprising a first compartment (1) containing a first composition and a second compartment (2) comprising a second composition, which process comprises: a. producing a first compartment (1); b. filling the first compartment (1) with the first composition; and either c. providing a sealing film comprising the second composition and sealing the first compartment (1) with the sealing film; or d. sealing the first compartment (1) with a sealing film; producing a second compartment (2) from the of sealing film of the first compartment (1); filling the second compartment (2) with the second composition; and sealing the sealing the second compartment (2) with a second sealing film. (same again).

WATER-SOLUBLE CONTAINERS COMPRISING AT LEAST TWO  
COMPARTMENTS

5

The present invention relates to a water-soluble container and to a process for preparing such a container.

10 It is known to package chemical compositions, particularly those which may be of a hazardous or irritant nature, in films, particularly water soluble films. Such containers can simply be added to water in order to dissolve or disperse the contents of the container into the water.

15 For example, WO 89/12587 discloses a package which comprises an envelope of a water soluble material which comprises a flexible wall and a water-soluble heat seal. The package may contain an organic liquid comprising, for example, a pesticide, fungicide, insecticide or herbicide.

20

WO 92/17382 discloses a package containing an agrochemical comprising a first sheet of non-planar water-soluble or water-dispersible material and a second sheet of water-soluble or water-dispersible material superposed on the first  
25 sheet and sealed to it.

WO93/08095 discloses a two compartment thermoformed sachet in which a formed pocket is filled with a first composition then a first film is laid over the first composition and the  
30 second composition is added over the top of the first film. Finally a second film is overlaid over the pocket and the two films are sealed to a sealing portion of the formed pocket.

The present application offers a simple process providing flexibility in the size and proportions of each compartment. In addition combinations of different formats, i.e. liquid first composition and solid second composition, are more easily produced and are more aesthetically pleasing.

We present as a feature of the invention a process for producing a water-soluble article comprising a first compartment containing a first composition and a second compartment comprising a second composition, which process comprises:

- a. producing a first compartment, for example in the form of a pocket;
  - 15 b. filling the first compartment with the first composition; and
- either
- 20 c. providing a sealing film comprising the second composition and sealing the first compartment with the sealing film;
- or
- 25 d. sealing the first compartment with a sealing film; producing a second compartment, for example in the form of a pocket, from the first compartment and/or the sealing film of the first compartment; filling the second compartment with the second composition; and sealing the
  - 30 second compartment with a second sealing film.

The preferred process of the invention is where the first compartment is sealed with a sealing film comprising the

second composition. The present invention provides a process for producing a water-soluble article comprising a first compartment, for example in the form of a pocket, said compartment being sealed with a sealing film, wherein said  
5 sealing film comprises a second composition, for example held within a second compartment, which process comprises:

- a. producing a first compartment;
- b. filling the first compartment with the first  
10 composition; and
- c. providing a sealing film comprising a second composition and sealing the first compartment with the sealing film.

The present invention also provides a water-soluble article  
15 obtainable by a process as defined herein.

The term "water soluble" is taken to include water dispersible. The term "water-soluble" when used herein means that when used in a washing machine, such as a fabric or dish  
20 washing machine, the water-soluble aspects of the article are substantially (greater than 70%, ideally greater than 85%) dissolved or dispersed into the water. This can be tested by placing the article in 10 litres of agitated water at 45°C for 40 minutes and measuring any undissolved or non-  
25 disintegrated pieces of the parts of the article, which are water-soluble, that are left.

The containers of the present invention can have a particularly attractive appearance since they contain two  
30 compositions held in a fixed position in relation to each other. The compositions can be easily differentiated to accentuate their difference. For example, the compositions can have a different physical appearance, or can be coloured

differently. Thus, for example, the containers can have an appearance of a fried egg or eyeball.

The container may contain two components which are  
5 incompatible with each other. It may also contain a component which is incompatible with the part of the container enclosing the other component. For example, the second composition may be incompatible with the part of the container enclosing the first composition.

10

The invention allows the use of multi-compartment sachets wherein the first composition and the second composition are each intended to be released into an aqueous environment, for example, a pharmaceutical or neutraceutical composition, an  
15 agricultural or pesticidal composition or a hazardous compound potentially toxic or damaging to health or to the environment.

It is possible to ensure that the components are released at  
20 different times. Thus, for instance, one composition can be released immediately the container is added to water, whereas the other may be released later. This may be achieved by having a compartment which takes longer to dissolve surrounding one of the compositions, which may be either the  
25 first or the second composition. This may be achieved, for example, by having different compartment thicknesses or different compartment materials or coatings. Alternatively, in one embodiment of the invention, the second composition may simply be held on the outside of the sealing film, in  
30 which case it can start to dissolve as soon as the article is added to water. It may also be achieved by choosing compartments which dissolve at different temperatures, for

example the different temperatures encountered during the cycle of a laundry or dish washing machine.

The first compartment may be formed of, for example, a  
5 moulded polymer, especially one produced by injection  
moulding or blow moulding. Injection moulding of water-  
soluble polymers is taught in WO01/36290. The walls of the  
compartment may, for example, have a thickness of greater  
than 100  $\mu\text{m}$ , for example greater than 150  $\mu\text{m}$  or greater than  
10 200  $\mu\text{m}$ , 300  $\mu\text{m}$ , 500  $\mu\text{m}$ , 750  $\mu\text{m}$  or 1mm. Preferably the walls  
have a thickness of from 200 to 400 $\mu\text{m}$ .

It will be appreciated that the first compartment may be  
rigid or flexible. The first compartment is preferably rigid  
15 when the first compartment is sealed with a sealing film  
comprising the second composition.

The first compartment may also, for example, be formed of a  
film. Preferably the first compartment is made from a film,  
20 and ideally the second compartment is formed from the film of  
the first compartment or the sealing film thereof or  
preferably from both the film of the compartment and the  
sealing film thereof.

25 Where a film is used it may be a single film, or a laminated  
film as disclosed in GB-A-2,244,258 or a coated film. While  
a single film may have pinholes, the two or more layers in a  
laminate are unlikely to have pinholes which coincide.

30 The film may be produced by any process, for example by  
extrusion and blowing or by casting. The film may be  
unoriented, monoaxially oriented or biaxially oriented. If  
the layers in the film are oriented, they usually have the

same orientation, although their planes of orientation may be different if desired.

The layers in a laminate may be the same or different. Thus  
5 they may each comprise the same polymer or different polymers.

Examples of water-soluble polymers which may be used in a single layer film or in one or more layers of a laminate or  
10 which may be used for injection moulding or blow moulding are poly(vinyl alcohol) (PVOH), cellulose derivatives such as hydroxypropyl methyl cellulose (HPMC), soluble polyurethane resins and gelatin. An example of a preferred PVOH is ethoxylated PVOH. The PVOH may be partially or fully  
15 alcoholised or hydrolysed. For example it may be from 40 to 100%, preferably from 70 to 92%, more preferably about 88% or about 92%, alcoholised or hydrolysed. The degree of hydrolysis is known to influence the temperature at which the PVOH starts to dissolve in water. 88% hydrolysis corresponds  
20 to a film soluble in cold (ie room temperature) water, whereas 92% hydrolysis corresponds to a film soluble in warm water.

The thickness of the film used to produce the first  
25 compartment, which may be in the form of a pocket, is preferably 40 to 300  $\mu\text{m}$ , more preferably 80 to 200  $\mu\text{m}$ , especially 100 to 160  $\mu\text{m}$ , more especially 100 to 150  $\mu\text{m}$  and ideally 60 to 120  $\mu\text{m}$ .

30 The film used for the first compartment or the sealing film of the first or second container is preferably part of a continuous film web.

The compartment may be formed by, for example, vacuum forming or thermoforming. For example, in a thermoforming process the film may be drawn down or blown down into a mould. Thus, for example, the film is heated to the thermoforming  
5 temperature using a thermoforming heater plate assembly, and then drawn down under vacuum or blown down under pressure into the mould. Plug-assisted thermoforming and pre-stretching the film, for example by blowing the film away from the mould before thermoforming, may, if desired, be  
10 used. One skilled in the art can choose an appropriate temperature, pressure or vacuum and dwell time to achieve an appropriate pocket. The amount of vacuum or pressure and the thermoforming temperature used depend on the thickness of the film and on the polymer or mixture of polymers being used.  
15 Thermoforming of PVOH films is known and described in, for example, WO 00/55045.

A suitable forming temperature for PVOH or ethoxylated PVOH is, for example, from 90 to 130°C, especially 90 to 120°C. A  
20 suitable forming pressure is, for example, 69 to 138kPa (10 to 20 p.s.i.), especially 83 to 117 kPa (12 to 17 p.s.i.). A suitable forming vacuum is 0 to 4 kPa (0 to 40 mbar), especially 0 to 2 kPa (0 to 20 mbar). A suitable dwell time is, for example, 0.4 to 2.5 seconds, especially 2 to 2.5  
25 seconds.

While desirably conditions are chosen within the above ranges, it is possible to use one or more of these parameters outside the above ranges, although it may be necessary to  
30 compensate by changing the values of the other two parameters.



The first compartment is filled with the desired first composition. The first compartment may be completely filled or only partially filled. The composition may be a solid. For example, it may be a particulate or granulated solid, or  
5 a tablet. It may also be a liquid, which may be thickened or gelled if desired. The liquid composition may be non-aqueous or aqueous, for example comprising less than or more than 5% total or free water respectively. The composition may have more than one phase. For example it may comprise an aqueous  
10 composition and a liquid composition which is immiscible with the aqueous composition. It may also comprise a liquid composition and a separate solid composition, for example in the form of a ball, pill or speckles.

15 The composition may be any composition that is intended to be released in an aqueous environment. Thus, for example, it may be an agrochemical composition such as a plant protection agent; for instance a pesticide, such as an insecticide, a fungicide, an herbicide, an acaricide, or a nematocide; a  
20 plant growth regulator or a plant nutrient. Such compositions are generally packaged in amounts of from 0.1 g to 7 kg, preferably 1g to 5 kg, when in solid form. When in liquid or gelled form, such compositions are generally packaged in amounts of from 1 ml to 10 litres, preferably 0.1  
25 to 6 litres, especially from 0.25 to 1.5 litres.

The composition may be any composition intended for pharmaceutical or neutraceutical use. Thus, for example, it may be a cold or flu remedy, or any other medicine, which may  
30 be added to a drink, or it may be a vitamin, mineral or plant extract.

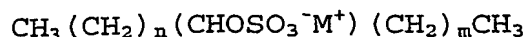
The composition may be hazardous product, especially one which should not be handled directly or contact the skin.

The first composition may also be a fabric care, surface care  
5 or dishwashing composition. Thus, for example, it may be a dishwashing, water-softening, laundry or detergent composition, or a rinse aid. Such compositions may be suitable for use in a domestic washing machine. The composition may also be a disinfectant, antibacterial or  
10 antiseptic composition, or a refill composition for a trigger-type spray. Such compositions are generally packaged in amounts of from 5 to 100 g, especially from 15 to 40 g. For example, a dishwashing composition may weigh from 15 to 30 g, a water-softening composition may weigh from 15 to 40  
15 g.

The composition, if in liquid form, may be anhydrous or comprise water, for example at least 5 wt %, preferably at least 10 wt% water based on the weight of the composition.  
20 Desirably the composition contains less than 80 wt% water. By "anhydrous" we mean that there is present less than 3 wt % of water, and ideally less than 0.5 wt %.

The remaining ingredients of the first composition depend on  
25 the use of the composition. Thus, for example, the composition may contain surface active agents such as an anionic, nonionic, cationic, amphoteric or zwitterionic surface active agents or mixtures thereof.

30 Examples of secondary alkyl sulfate surfactants are those which have the sulfate moiety on a "backbone" of the molecule, for example those of formula:



10

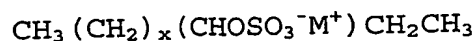
wherein m and n are independently 2 or more, the sum of m+n typically being 6 to 20, for example 9 to 15, and M is a water-solubilising cation such as lithium, sodium or potassium.

5

Especially preferred secondary alkyl sulfates are the (2,3) alkyl sulfate surfactants of formulae:



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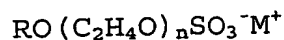


15

for the 2-sulfate and 3-sulfate, respectively. In these formulae x is at least 4, for example 6 to 20, preferably 10 to 16. M is cation, such as an alkali metal, for example lithium, sodium or potassium.

Examples of alkoxyated alkyl sulfates are ethoxylated alkyl sulfates of the formula:

20



25

wherein R is a  $\text{C}_8$ - $\text{C}_{20}$  alkyl group, preferably  $\text{C}_{10}$ - $\text{C}_{18}$  such as a  $\text{C}_{12}$ - $\text{C}_{16}$ , n is at least 1, for example from 1 to 20, preferably 1 to 15, especially 1 to 6, and M is a salt-forming cation such as lithium, sodium, potassium, ammonium, alkylammonium or alkanolammonium. These compounds can provide especially desirable fabric cleaning performance benefits when used in combination with alkyl sulfates.

30

The alkyl sulfates and alkyl ether sulfates will generally be used in the form of mixtures comprising varying alkyl chain lengths and, if present, varying degrees of alkoxylation.

Other anionic surfactants which may be employed are salts of fatty acids, for example C<sub>8</sub>-C<sub>18</sub> fatty acids, especially the sodium or potassium salts, and alkyl, for example C<sub>8</sub>-C<sub>18</sub>,  
5 benzene sulfonates.

Examples of nonionic surfactants are fatty acid alkoxyates, such as fatty acid ethoxyates, especially those of formula:

10  $R(C_2H_4O)_nOH$

wherein R is a straight or branched C<sub>8</sub>-C<sub>16</sub> alkyl group, preferably a C<sub>9</sub>-C<sub>15</sub>, for example C<sub>10</sub>-C<sub>14</sub>, alkyl group and n is at least 1, for example from 1 to 16, preferably 2 to 12,  
15 more preferably 3 to 10.

The alkoxyated fatty alcohol nonionic surfactant will frequently have a hydrophilic-lipophilic balance (HLB) which ranges from 3 to 17, more preferably from 6 to 15, most  
20 preferably from 10 to 15.

Examples of fatty alcohol ethoxyates are those made from alcohols of 12 to 15 carbon atoms and which contain about 7 moles of ethylene oxide. Such materials are commercially  
25 marketed under the trademarks Neodol 25-7 and Neodol 23-6.5 by Shell Chemical Company. Other useful Neodols include Neodol 1-5, an ethoxyated fatty alcohol averaging 11 carbon atoms in its alkyl chain with about 5 moles of ethylene oxide; Neodol 23-9, an ethoxyated primary C<sub>12</sub>-C<sub>13</sub> alcohol  
30 having about 9 moles of ethylene oxide; and Neodol 91-10, an ethoxyated C<sub>9</sub>-C<sub>11</sub> primary alcohol having about 10 moles of ethylene oxide.

Alcohol ethoxylates of this type have also been marketed by Shell Chemical Company under the Dobanol trademark. Dobanol 91-5 is an ethoxylated C<sub>9</sub>-C<sub>11</sub> fatty alcohol with an average of 5 moles ethylene oxide and Dobanol 25-7 is an ethoxylated C<sub>12</sub>-C<sub>15</sub> fatty alcohol with an average of 7 moles of ethylene oxide per mole of fatty alcohol.

Other examples of suitable ethoxylated alcohol nonionic surfactants include Tergitol 15-S-7 and Tergitol 15-S-9, both of which are linear secondary alcohol ethoxylates available from Union Carbide Corporation. Tergitol 15-S-7 is a mixed ethoxylated product of a C<sub>11</sub>-C<sub>15</sub> linear secondary alkanol with 7 moles of ethylene oxide and Tergitol 15-S-9 is the same but with 9 moles of ethylene oxide.

15

Other suitable alcohol ethoxylated nonionic surfactants are Neodol 45-11, which is a similar ethylene oxide condensation products of a fatty alcohol having 14-15 carbon atoms and the number of ethylene oxide groups per mole being about 11. Such products are also available from Shell Chemical Company.

20

Further nonionic surfactants are, for example, C<sub>10</sub>-C<sub>18</sub> alkyl polyglycosides, such as C<sub>12</sub>-C<sub>16</sub> alkyl polyglycosides, especially the polyglucosides. These are especially useful when high foaming compositions are desired. Further surfactants are polyhydroxy fatty acid amides, such as C<sub>10</sub>-C<sub>18</sub> N-(3-methoxypropyl) glycamides and ethylene oxide-propylene oxide block polymers of the Pluronic type.

25

Examples of cationic surfactants are those of the quaternary ammonium type.

30

The total content of surfactants in the composition is desirably 60 to 95 wt%, especially 75 to 90 wt%. Desirably an anionic surfactant is present in an amount of 50 to 75 wt%, the nonionic surfactant is present in an amount of 5 to 50 wt%, and/or the cationic surfactant is present in an amount of from 0 to 20 wt%. The amounts are based on the total solids content of the composition, i.e. excluding any solvent which may be present.

- 10 The first and second compositions, particularly when used as laundry washing or dishwashing compositions, may also independently comprise enzymes, such as protease, lipase, amylase, cellulase and peroxidase enzymes. Such enzymes are commercially available and sold, for example, under the
- 15 registered trade marks Esperase, Alcalase and Savinase by Nova Industries A/S and Maxatase by International Biosynthetics, Inc. Desirably the enzymes are independently present in the first or second compositions in an amount of from 0.5 to 3 wt%, especially 1 to 2 wt%, when added as
- 20 commercial preparations they are not pure and this represents an equivalent amount of 0.005 to 0.5 wt% of pure enzyme.

- The first and second compositions may, if desired, independently comprise a thickening agent or gelling agent.
- 25 Suitable thickeners are polyacrylate polymers such as those sold under the trade mark CARBOPOL, or the trade mark ACUSOL by Rohm and Haas Company. Other suitable thickeners are xanthan gums. The thickener, if present, is generally present in an amount of from 0.2 to 4 wt%, especially 0.5 to
- 30 2 wt%.

First or second compositions used in dishwashing independently usually comprise a detergency builder. The

builders counteract the effects of calcium, or other ion, water hardness encountered. Examples of such materials are citrate, succinate, malonate, carboxymethyl succinate, carboxylate, polycarboxylate and polyacetyl carboxylate salts, for example with alkali metal or alkaline earth metal cations, or the corresponding free acids. Specific examples are sodium, potassium and lithium salts of oxydisuccinic acid, mellitic acid, benzene polycarboxylic acids, C<sub>10</sub>-C<sub>22</sub> fatty acids and citric acid. Other examples are organic phosphonate type sequestering agents such as those sold by Monsanto under the trade mark Dequest and alkylhydroxy phosphonates. Citrate salts and C<sub>12</sub>-C<sub>18</sub> fatty acid soaps are preferred. Further builders are; phosphates such as sodium, potassium or ammonium salts of mono-, di- or tri-poly or oligo-phosphates; zeolites; silicates, amorphous or structured, such as sodium, potassium or ammonium salts. Further builders are; phosphates such as sodium, potassium or ammonium salts of mono-, di- or tri-poly or oligo-phosphates; zeolites; silicates, amorphous or structured, such as sodium, potassium or ammonium salts.

Other suitable builders are polymers and copolymers known to have builder properties. For example, such materials include appropriate polyacrylic acid, polymaleic acid, and polyacrylic/polymaleic and copolymers and their salts, such as those sold by BASF under the trade mark Sokalan.

The builder is desirably present in an amount of up to 90 wt%, preferably 15 to 90 wt%, more preferable 15 to 75 wt%, relative to the total weight of the composition. Further details of suitable components are given in, for example, EP-A-694,059, EP-A-518,720 and WO 99/06522.

The first and second compositions can also independently optionally comprise one or more additional ingredients. These include conventional detergent composition components such as further surfactants, bleaches, bleach enhancing  
5 agents, builders, suds boosters or suds suppressors, anti-tarnish and anti-corrosion agents, organic solvents, co-solvents, phase stabilisers, emulsifying agents, preservatives, soil suspending agents, soil release agents, germicides, pH adjusting agents or buffers, non-builder  
10 alkalinity sources, chelating agents, clays such as smectite clays, enzyme stabilizers, anti-limescale agents, colourants, dyes, hydrotropes, dye transfer inhibiting agents, brighteners, and perfumes. If used, such optional ingredients will generally constitute no more than 15 wt%,  
15 for example from 1 to 6 wt%, the total weight of the compositions.

First or second compositions which comprise an enzyme may optionally contain materials which maintain the stability of  
20 the enzyme. Such enzyme stabilizers include, for example, polyols such as propylene glycol, boric acid and borax. Combinations of these enzyme stabilizers may also be employed. If utilized, the enzyme stabilizers generally constitute from 0.1 to 5 wt%, ideally 0.1 to 1 wt% of the  
25 compositions.

The first and second compositions may independently optionally comprise materials which serve as phase stabilizers and/or co-solvents. Example are C<sub>1</sub>-C<sub>3</sub> alcohols  
30 such as methanol, ethanol and propanol. C<sub>1</sub>-C<sub>3</sub> alkanolamines such as mono-, di- and triethanolamines can also be used, by themselves or in combination with the alcohols. The phase



stabilizers and/or co-solvents can, for example, constitute 0 to 1 wt%, preferably 0.1 to 0.5 wt%, of the composition.

The first and second compositions may independently optionally comprise components which adjust or maintain the pH of the compositions at optimum levels. The pH may be from, for example, 1 to 13, such as 8 to 11 depending on the nature of the composition. For example a dishwashing composition desirably has a pH of 8 to 11, a laundry composition desirable has a pH of 7 to 9, and a water-softening composition desirably has a pH of 7 to 9. Examples of pH adjusting agents are NaOH and citric acid.

The above examples may be used for dish or fabric washing. In particular dish washing formulations are preferred which are adapted to be used in automatic dish washing machines. Due to their specific requirements specialised formulation are required and these are illustrated below

Amounts of the ingredients can vary within wide ranges, however preferred automatic dishwashing detergent compositions herein (which typically have a 1% aqueous solution pH of above 8, more preferably from 9.5 to 12, most preferably from 9.5 to 10.5) are those wherein there is present: from 5% to 90%, preferably from 5% to 75%, of builder; from 0.1% to 40%, preferably from 0.5% to 30%, of bleaching agent; from 0.1% to 15%, preferably from 0.2% to 10%, of the surfactant system; from 0.0001% to 1%, preferably from 0.001% to 0.05%, of a metal-containing bleach catalyst; and from 0.1% to 40%, preferably from 0.1% to 20% of a water-soluble silicate. Such fully-formulated embodiments typically further comprise from 0.1% to 15% of a polymeric dispersant, from 0.01% to 10% of a chelant, and from 0.00001% to 10% of a

deterative enzyme, though further additional or adjunct ingredients may be present. Detergent compositions herein in granular form typically limit water content, for example to less than 7% free water, for better storage stability.

5

Non-ionic surfactants useful in ADW (Automatic Dish Washing) compositions of the present invention desirably include surfactant(s) at levels of from 2% to 60% of the composition. In general, bleach-stable surfactants are preferred. Non-  
10 ionic surfactants generally are well known, being described in more detail in Kirk Othmer's Encyclopedia of Chemical Technology, 3rd Ed., Vol. 22, pp. 360-379, "Surfactants and Deterative Systems", incorporated by reference herein.

15 Preferably the ADW composition comprises at least one non-ionic surfactant. One class of non-ionics are ethoxylated non-ionic surfactants prepared by the reaction of a monohydroxy alkanol or alkylphenol with 6 to 20 carbon atoms with preferably at least 12 moles particularly preferred at  
20 least 16 moles, and still more preferred at least 20 moles of ethylene oxide per mole of alcohol or alkylphenol.

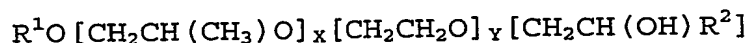
Particularly preferred non-ionic surfactants are the non-ionic from a linear chain fatty alcohol with 16-20 carbon  
25 atoms and at least 12 moles particularly preferred at least 16 and still more preferred at least 20 moles of ethylene oxide per mole of alcohol.

According to one preferred embodiment the non-ionic  
30 surfactant additionally comprise propylene oxide units in the molecule. Preferably this PO units constitute up to 25% by weight, preferably up to 20% by weight and still more preferably up to 15% by weight of the overall molecular

weight of the non-ionic surfactant. Particularly preferred surfactants are ethoxylated mono-hydroxy alkanols or alkylphenols, which additionally comprises polyoxyethylene-polyoxypropylene block copolymer units. The alcohol or  
 5 alkylphenol portion of such surfactants constitutes more than 30%, preferably more than 50%, more preferably more than 70% by weight of the overall molecular weight of the non-ionic surfactant.

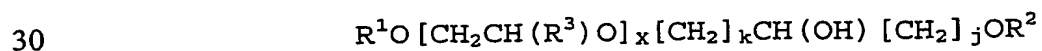
10 Another class of non-ionic surfactants includes reverse block copolymers of polyoxyethylene and polyoxypropylene and block copolymers of polyoxyethylene and polyoxypropylene initiated with trimethylolpropane.

15 Another preferred non-ionic surfactant can be described by the formula:



20 wherein  $R^1$  represents a linear or branched chain aliphatic hydrocarbon group with 4-18 carbon atoms or mixtures thereof,  $R^2$  represents a linear or branched chain aliphatic hydrocarbon rest with 2-26 carbon atoms or mixtures thereof,  $x$  is a value between 0.5 and 1.5 and  $y$  is a value of at least  
 25 15.

Another group of preferred nonionic surfactants are the end-capped polyoxyalkylated non-ionics of formula:

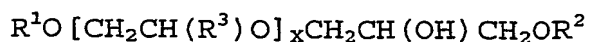


wherein  $R^1$  and  $R^2$  represent linear or branched chain, saturated or unsaturated, aliphatic or aromatic hydrocarbon

groups with 1-30 carbon atoms,  $R^3$  represents a hydrogen atom or a methyl, ethyl, n-propyl, iso-propyl, n-butyl, 2-butyl or 2-methyl-2-butyl group,  $x$  is a value between 1 and 30 and,  $k$  and  $j$  are values between 1 and 12, preferably  
 5 between 1 and 5. When the value of  $x$  is  $\geq 2$  each  $R^3$  in the formula above can be different.  $R^1$  and  $R^2$  are preferably linear or branched chain, saturated or unsaturated, aliphatic or aromatic hydrocarbon groups with 6-22 carbon atoms, where group with 8 to 18 carbon atoms are particularly  
 10 preferred. For the group  $R^3$  H, methyl or ethyl are particularly preferred. Particularly preferred values for  $x$  are comprised between 1 and 20, preferably between 6 and 15.

As described above, in case  $x \geq 2$ , each  $R^3$  in the formula can  
 15 be different. For instance, when  $x=3$ , the group  $R^3$  could be chosen to build ethylene oxide ( $R^3=H$ ) or propylene oxide ( $R^3=\text{methyl}$ ) units which can be used in every single order for instance (PO)(EO)(EO), (EO)(PO)(EO), (EO)(EO)(PO), (EO)(EO)(EO), (PO)(EO)(PO), (PO)(PO)(EO) and (PO)(PO)(PO).  
 20 The value 3 for  $x$  is only an example and bigger values can be chosen whereby a higher number of variations of (EO) or (PO) units would arise.

Particularly preferred end-capped polyoxyalkylated alcohols  
 25 of the above formula are those where  $k=1$  and  $j=1$  originating molecules of simplified formula:



30 The use of mixtures of different non-ionic surfactants is particularly preferred in ADW formulations for example mixtures of alkoxyated alcohols and hydroxy group containing alkoxyated alcohols.

The first composition and the second composition may be the same or different. If they are different, they may, nevertheless, have one or more individual components in common.

5

After the first compartment has been filled, a sealing film is placed on top of the first compartment and sealed thereto.

10 In one alternative the sealing film comprises a second composition at the time it is placed on top of the first compartment. This may be held or otherwise adhered on the sealing film. For example it can be in the form of a solid composition such as a ball or pill held on the sealing member by an adhesive or by mechanical means. This is especially  
15 appropriate when the sealing film has a degree of rigidity. It is also possible for a previously prepared container containing the second composition to be adhered to the sealing film. For example, a sealing film may have a filled compartment containing a composition attached therebetween,  
20 within or to the sealing film. Preferably the first compartment is sealed by the sealing film of the second compartment.

The second composition or compartment may be held on either  
25 side of the sealing film such that it is inside or outside the first compartment.

Generally, however, the second composition is held within a second compartment in the sealing film. This is especially  
30 appropriate when the sealing film is flexible.

The sealing film is placed on top of the first compartment and sealed thereto. For example the sealing film may be

placed over a filled compartment and across the sealing portion, if present, and the films sealed together at the sealing portion. In general there is only one second compartment or composition within or on the sealing film, but  
5 it is possible to have more than one second compartment or composition if desired, for example 2 or 3 second compartments or compositions.

The second compartment may be formed by any technique. For  
10 example it can be formed by vertical form fill sealing the second composition within a film, such as by the process described in WO 89/12587.

However, it is preferred to use vacuum forming or  
15 thermoforming techniques, such as that previously described in relation to the first compartment of the container of the present invention. Thus, for example, a pocket surrounded by a sealing portion is formed in a film, the pocket is filled with the second composition, a film is placed on top of the  
20 filled pocket and across the sealing portion and the 3 films are sealed together at the sealing portion.

Further details of this thermoforming process are generally the same as those given above in relation to the first  
25 compartment of the container of the present invention. All of the above details are incorporated by reference to the second compartment, with the following differences:

The second compartment is generally smaller than the first  
30 compartment since the film containing the second composition is used to form a lid on the first compartment. In general the first compartment and the second compartment (or composition if not held within a compartment) have a volume

ratio of from 2:1 to 20:1, preferable 4:1 to 10:1. Generally the second compartment does not extend across the sealing portion.

- 5 The thickness of the film or films comprising the second compartment may also be less than the thickness of the film making up the first compartment of the container of the present invention, because the film or films are not subjected to as much localised stretching in the
- 10 thermoforming step. It is also desirable to have a thickness which is less than that of the film used to form the first compartment to ensure a sufficient heat transfer through the film to soften the base web if heat sealing is used.
- 15 The thickness of the covering film is generally from 20 to 160  $\mu\text{m}$ , preferably from 40 to 100  $\mu\text{m}$ , such as 40 to 80  $\mu\text{m}$  or 50 to 60  $\mu\text{m}$ .

- This sealing film may be a single-layered film but is
- 20 desirably laminated to reduce the possibility of pinholes allowing leakage through the film. The film may be the same or different as the film forming the first compartment. If two or more films are used to form the film comprising the second compartment, the films may be the same or different.
- 25 Examples of suitable films are those given for the film forming the first compartment.

- The first compartment and the sealing film may be sealed together by any suitable means, for example by means of an
- 30 adhesive or by heat sealing. Other methods of sealing include infra-red, radio frequency, ultrasonic, laser, solvent, vibration and spin welding. An adhesive such as an aqueous

solution of PVOH may also be used. The seal desirably is water-soluble.

If heat sealing is used, a suitable sealing temperature is, for example, 120 to 195°C, for example 140 to 150°C. A suitable sealing pressure is, for example, from 250 to 600 kPa. Examples of sealing pressures are 276 to 552 kPa (40 to 80 p.s.i.), especially 345 to 483 kPa (50 to 70 p.s.i.) or 400 to 800 kPa (4 to 8 bar), especially 500 to 700 kPa (5 to 7 bar) depending on the heat sealing machine used. Suitable sealing dwell times are 0.4 to 2.5 seconds.

One skilled in the art can use an appropriate temperature, pressure and dwell time to achieve a seal of the desired integrity. While desirably conditions are chosen within the above ranges, it is possible to use one or more of these parameters outside the above ranges, although it would might be necessary to compensate by changing the values of the other two parameters.

20

In an alternative arrangement the first compartment is sealed with a sealing film not comprising a second composition. In such an alternative the second compartment is formed from the sealing film of the first compartment. It will be appreciated that there should be some flexibility in the first compartment for the forming stage of the second compartment, especially at the points at which the sealing film is attached to the first compartment.

Therefore, preferably, the first compartment is formed from a film and the second compartment is then formed from the sealing film and the film of the first compartment including the parts where the sealing film and the film of the



container are attached. Alternatively the second compartment is formed from just the sealing film, or from the film of the first container.

- 5 Suitable forming techniques for the second compartment are those as described above for vacuum and thermoforming the first compartment.

10 After forming the second compartment that compartment is filled with the second composition, the second composition being as described above. The second compartment is then sealed with a second sealing film, which can be from materials, of thicknesses and sealed using techniques as described above.

15 It will be appreciated that in this alternative of the invention, unlike the first alternative, the second compartment will be larger than the first compartment, with the volume ratios as described above, but in reverse.

20 If more than one container is formed at the same time from the same sheet, the containers may then be separated from each other, for example by cutting around the sealing portions, or flanges. Alternatively, they may be left  
25 conjoined and, for example, perforations provided between the individual containers so that they can be easily separated at a later stage, for example by a consumer. If the containers are separated, the flanges are at least in part left in place. However, desirably the flanges are partially removed  
30 in order to provide an even more attractive appearance. Generally the flanges remaining should be as small as possible for aesthetic purposes while bearing in mind that some flange is required to ensure the two films remain

adhered to each other. A flange having a width of 1 mm to 8 mm is desirable, preferably 2 mm to 7 mm, most preferably about 5 mm.

5

The containers may themselves be packaged in outer containers if desired, for example non-water soluble containers which are removed before the water-soluble containers are used.

- 10 The containers produced by the process of the present invention, especially when used for a fabric care, surface care or dishwashing composition, may have a maximum dimension of 5 cm, excluding any flanges. For example, a container may have a length of 1 to 5 cm, especially 3.5 to 4.5 cm, a width  
15 of 1.5 to 3.5 cm, especially 2 to 3 cm, and a height of 1 to 2 cm, especially 1.25 to 1.75 cm.

The first composition and the second composition may be appropriately chosen depending on the desired use of the  
20 article.

- If the article is for use in laundry washing, the first composition may comprise, for example, a detergent, and the second composition may comprise a bleach, stain remover,  
25 water-softener, enzyme or fabric conditioner. The article may be adapted to release the compositions at different times during the laundry wash. For example, a bleach or fabric conditioner is generally released at the end of a wash, and a water-softener is generally released at the start of a wash.  
30 An enzyme may be released at the start or the end of a wash.

If the article is for use as a fabric conditioner, the first composition may comprise a fabric conditioner and the second  
5 composition may comprise an enzyme which is released before or after the fabric conditioner in a rinse cycle.

If the article is for use in dish washing the first composition may comprise a detergent and the second  
10 composition may comprise a water-softener, salt, enzyme, rinse aid, bleach or bleach activator. The article may be adapted to release the compositions at different times during the laundry wash. For example, a rinse aid, bleach or bleach  
15 activator is generally released at the end of a wash, and a water-softener, enzyme is generally released at the start of a wash.

If the article is for use as an agrochemical product, the first compartment may comprise a plant feed and the second  
20 compartment may comprise a pesticidal composition.

If the article is for use as a pharmaceutical/nutraceutical composition, the first compartment may comprise a  
25 nutraceutical composition and the second compartment a pharmaceutical composition.

The containers of the present invention will now be further described with reference to figures 1 to 5. These illustrate  
30 examples of containers which can be produced

Each figure shows an article containing a first compartment 1 and a second composition 2. In figures 1 to 3, the second composition is held in a second compartment in a sealing

member in the form of a film. In figure 4 the second composition is simply held in a recess in the sealing member. In figure 5 the second compartment is formed by forming the sealing film comprising the first compartment 1, and the  
5 parts of the film of the first compartment 1 to which the sealing film is attached, into a compartment. The second compartment is then filled with composition 2 and sealed with a second sealing film.

CLAIMS

1. A process for producing a water-soluble article comprising  
5 a first compartment containing a first composition and a  
second compartment comprising a second composition, which  
process comprises:
- a. producing a first compartment;  
10 b. filling the first compartment with the first composition;  
and
- either
- 15 c. providing a sealing film comprising the second composition  
and sealing the first compartment with the sealing film;
- or
- 20 d. sealing the first compartment with a sealing film;  
producing a second compartment from the first compartment  
and/or the sealing film of the first compartment; filling  
the second compartment with the second composition; and  
sealing the second compartment with a second sealing film.
- 25
2. A process as claimed in claim 1 wherein the first  
compartment is made from a film and the second compartment  
is formed from the sealing film and the film of the first  
compartment.
- 30
3. A process as claimed in claim 2 wherein the second  
compartment is formed from the sealing film or from the  
film of the first container.

4. A process as claimed in any claim from 2 to 3 wherein the sealing film of the first compartment is part of a continuous web.

5

5. A process for producing a water-soluble article comprising a first compartment containing a first composition, said compartment being sealed with a sealing film, wherein said sealing film comprises a second composition, which process  
10 comprises:

a. producing a first compartment;  
b. filling the first compartment with the first composition; and

15 c. providing a sealing film comprising the second composition and sealing the first compartment with the sealing film.

6. A process according to any claim from 1 to 5 wherein the  
20 first compartment and the sealing film comprise a poly(vinyl alcohol).

7. A process according to any one of the preceding claims wherein the first compartment has been formed by  
25 thermoforming.

8. A process according to claim 5 wherein the first compartment has been made by injection moulding.

30 9. A process according to any one of the preceding claims wherein the first composition is a particulate solid, a gel or a liquid.

10. A process according to claim 5 wherein one of the compartments has been formed by a vertical form fill sealing method.
- 5 11. A process according to any one of claims 1 to 9 wherein at least one compartment has been formed by thermoforming.
- 10 12. A process according to any one of the preceding claims wherein the second composition is a particulate solid, a gel, a liquid or a compressed solid.
- 15 13. A process according to any one of the preceding claims wherein the first composition and the second composition are each a fabric care, surface care or dishwashing composition.
- 20 14. A process according to claim 13 wherein each composition is a dishwashing, water-softening, laundry or detergent composition or a rinse aid.
- 25 15. A process according to claim 13 wherein each composition is a disinfectant, antibacterial or antiseptic composition or a refill composition for a trigger-type spray.
- 30 16. A process according to any one of claims 1 to 12 wherein the first composition and the second composition are each compositions which are intended to be released into an aqueous environment for example, a pharmaceutical or neutraceutical composition, an agricultural or pesticidal composition or a hazardous compound potentially toxic or

damaging to health or to the environment.

17. A water-soluble article obtainable by a process as defined in any one of the preceding claims.



FIG. 1.

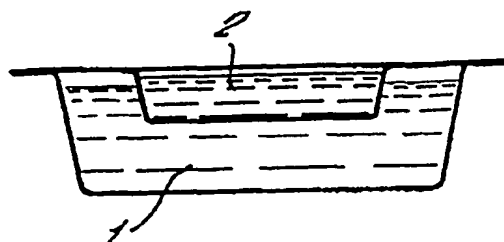


FIG. 2.

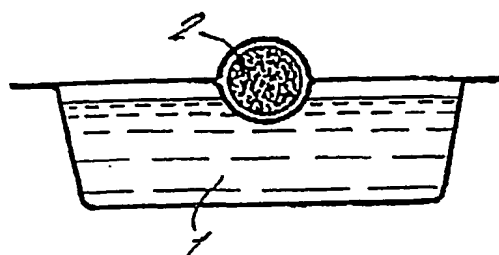


FIG. 3.

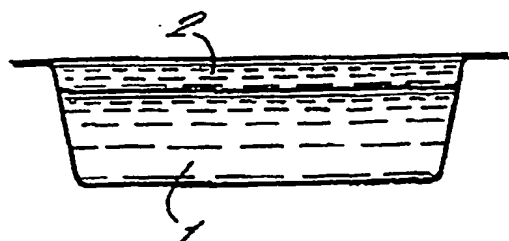


FIG. 4.

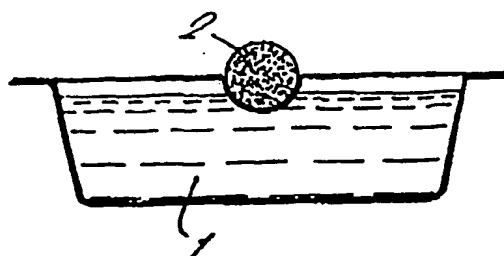
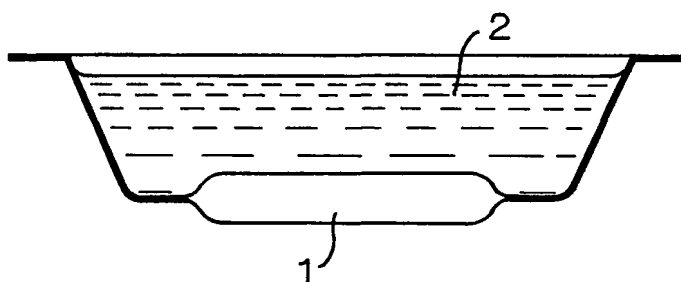


Fig.5.



## INTERNATIONAL SEARCH REPORT

Int'l Application No

PCT/GB 02/01786

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 B65D65/46 B65D81/32

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B65D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

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☐ Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

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- \*&\* document member of the same patent family

Date of the actual completion of the international search

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International Application No

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